Study on the Mechanism and Path of Realising the Value of Ecological Products in the Upper Yangtze River Basin Driven by Green Technology under the 'Dual Carbon' Goal

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ABSTRACT

In this study, we focus on how to drive the realisation of the value of ecological products in the Upper Yangtze River Basin through green technologies under the policy guidance of the Chinese government's 'double carbon' target, i.e., carbon peaking and carbon neutrality. As an ecologically sensitive and important region, the realisation of the value of ecological products in the Upper Yangtze River Basin is not only crucial for regional environmental protection and sustainable development, but also exemplary for achieving national environmental protection goals. This study explores in detail the current status of green technology application in the region and its contribution to the value realisation of ecological products. The analysis focuses on three major areas: green agricultural technologies, renewable energy technologies, and the development of eco-tourism, where technological innovations are particularly critical for enhancing the market value of eco-products and promoting environmental sustainability. The results of the study show that the value of ecological products in the upper reaches of the Yangtze River can be effectively realised through effective policy support and the improvement of market mechanisms, combined with extensive community participation. This not only contributes to the transformation and upgrading of the local economy, but also promotes the overall well-being of the community. Ultimately, we propose a series of recommendations for policymakers and practitioners aimed at maximising the value of eco-products through green technologies to support the sustainable development of the upper Yangtze River Basin in achieving the 'dual-carbon' goal.

Key words: Dual Carbon Goals; Green Technology; Upper Yangtze River Basin; Value of Ecological Products; Implementation Mechanism

1 INTRODUCTION

Against the backdrop of the severe environmental challenges and climate change issues facing the world today, China has put forward a 'double carbon' goal, i.e., to achieve carbon peak and carbon neutrality, in order to promote the country's green and low-carbon development. As an important ecological reserve in China, the ecological health of the Upper Yangtze River Basin is directly related to the water and ecological safety of many downstream provinces. Therefore, exploring how to realise the value of eco-products through green technologies in the Upper Yangtze River Basin, driven by the 'dual-carbon' goal, is not only a need for regional development, but also an important part of the national strategy [1].

The Upper Yangtze River Basin is rich in natural resources and biodiversity, but also faces environmental problems such as industrial pollution and over-exploitation of resources.

Realising the value of eco-products can not only promote the protection and restoration of the ecological environment, but also bring economic benefits to local communities, achieving a win-win situation between economic development and environmental protection. The application of green technologies, such as renewable energy and eco-agricultural technologies, provides technical support and new possibilities for value-added ecological products. Therefore, an in-depth study of the mechanisms and paths for realising the value of ecological products in the Upper Yangtze River Basin is of great significance in guiding the sustainable development of the region [2].

This study aims to explore the mechanisms and paths for realising the value of ecological products through green technologies in the Upper Yangtze River Basin, driven by the goal of 'dual carbon'. The study will use a variety of methods, including literature review, case studies, and quantitative and qualitative analyses, to comprehensively examine the effectiveness and potential of green technologies in realising the value of ecological products. Through this study, it is hoped that it will provide a theoretical basis and practical guide for the formulation of regional green development strategies, and contribute wisdom and strength to the realisation of environmental sustainability and coordinated economic and social development in the Upper Yangtze River Basin [3].

In summary, the significance of this study is not only to promote the ecological protection and economic development of the Upper Yangtze River Basin, but also to provide feasible demonstration and practical experience for the construction of ecological civilisation in China and the world. Through in-depth research and discussion, this paper will reveal the role mechanism of green technology in realising the value of ecological products, provide scientific basis for the formulation and implementation of relevant policies, and promote the harmonious development of ecology and economy.

2 THEORETICAL FOUNDATIONS AND RESEARCH METHODS

In studying the mechanisms and pathways for realising the value of ecological products in the upper Yangtze River basin under the 'dual-carbon' goal, we rely on environmental economics and sustainable development theory. Environmental economics emphasises the effective use of resources and the internalisation of environmental costs, while the theory of sustainable development provides a three-dimensional perspective of ecological, economic and social development. On this basis, the application of green technologies is seen as a key way to promote the transformation of ecological values, aiming to reduce the environmental footprint and improve the efficiency of resource use through technological innovation, while promoting coordinated economic and social development [4].

In order to explore this process in depth, this study adopts a variety of research methods. Firstly, qualitative research, in particular case study methodology, is used to analyse the effects and limitations of implemented green technology projects and policies, in order to obtain a preliminary understanding of the mechanisms of realising the value of eco-products. In addition, quantitative methods are used to measure the specific effects of green technology implementation, including statistical analysis of data and model simulation. These methods help us to assess the environmental benefits and economic impacts of green technologies in different contexts, as well as to predict future trends [5].

In terms of data sources, this study mainly utilises environmental and economic data released by the government, relevant studies in academic journals and reports, and primary data obtained through field research. The field research was conducted especially for the agriculture, energy and tourism sectors in the Upper Yangtze River Basin, which are the main areas of green technology application in the region. Through this integration of multiple sources of data, we are able to comprehensively analyse how green technologies can realise

the value of eco-products in specific regional environments, thus providing a scientific basis for policy formulation and technology promotion [6].

Figure 1: All municipalities in the Upper Yangtze River Basin - GEP2023

The map shows the Gross Ecological Product (GEP) values for cities in the Upper Yangtze River Basin in 2023. The data is colour-coded to indicate different GEP ranges and is divided into three categories: light green for GEP values between 1.27 and 1.78, yellow green for GEP values between 2.31 and 2.66, and blue for GEP values between 2.76 and 3.3. These colours and values help to visualise the ecological outputs or values produced by different areas of the catchment.

From the map, we can observe that cities such as Chongqing and Ganzi Tibetan have relatively high GEP values, marked in blue, which suggests that these areas may be better at managing ecological resources or have more valuable ecological assets. This may be attributed to effective environmental policies, the presence of important natural resources, or a high focus on sustainable development practices. In contrast, lighter green cities such as Diqing Tibetan and Liangshan Yi Autonomous Prefecture have lower GEP values, which may indicate less optimisation of ecological assets or less emphasis on ecological productivity [7].

This spatial distribution may reflect different levels of economic development, resource availability and environmental management strategies in the region. Higher GEP values in some regions may also indicate a greater reliance on ecotourism, sustainable agriculture, or other green industries that contribute positively to the region's ecological wealth. Conversely, regions with lower GEP values may need to focus on improving ecological management practices, enhancing conservation efforts, or developing industries that minimise negative environmental impacts [8].

This data is also critical for regional planning and policy development, as it provides insight into how different regions contribute to the overall ecological health of the Upper Yangtze River Basin. Understanding these dynamics can help target investments and interventions where they are most needed to improve ecological productivity and sustainability, ensuring balanced regional development and conservation of critical ecosystems in this important basin.

3 ECOLOGICAL STATUS OF THE UPPER YANGTZE RIVER BASIN AND THE 'DUAL CARBON' GOAL

The ecological health status of the Upper Yangtze River Basin, as an important water-source containment area and biodiversity reserve in China, is of irreplaceable importance to the environmental security and water resource management of the entire Yangtze River and even Southeast Asia. However, this region faces environmental pressures

due to long-term industrial activities, overexploitation and climate change. Soil erosion, destruction of biological habitats and water quality pollution remain serious problems that challenge the natural resilience of the ecosystem. In addition, the geographical characteristics of the upper reaches of the Yangtze River make it more vulnerable to the impacts of climate change, such as an increase in the frequency and intensity of heavy rainfalls and droughts, which greatly affect the livelihoods of local residents and the sustainable development of the regional economy.

The ecological protection and restoration of the Upper Yangtze River Basin has been given a new opportunity to develop, driven by the 'dual carbon' goals of the Chinese government's Peak Carbon Achievement and Carbon Neutrality Targets. This policy framework promotes the acceleration of the transition from the traditional development model to a low-carbon, environmentally friendly one, especially in the optimisation of the energy structure, industrial upgrading, and the development and utilisation of new energy sources. Through these measures, it not only reduces greenhouse gas emissions, but also helps to improve and rehabilitate the local ecological environment. For example, the construction of hydropower stations and solar power projects in the upper reaches of the Yangtze River not only meets the energy needs of the region, but also reduces reliance on fossil fuels, helping to reduce carbon emissions and protect the ecological environment [9].

In addition, the 'dual-carbon' goal has prompted local governments and enterprises to place greater emphasis on environmental protection and technological innovation. The introduction of new policies and technologies, such as green agricultural practices, eco-tourism and eco-compensation mechanisms, has not only increased the economic value of eco-products, but also raised the environmental awareness and participation of community residents. In this way, the ecological restoration work in the upper reaches of the Yangtze River has been able to gain the support and co-operation of local communities, forming a strong synergy to protect the ecological environment. At the same time, this has led to the development of the market for related ecological products and services, which has provided the impetus for realising the green growth of the regional economy.

In summary, although the ecological status quo of the Upper Yangtze River Basin faces multiple challenges, the prospects for ecological protection and sustainable development in the region are gradually improving under the guidance of the 'dual-carbon' goal and through policy promotion and technological innovation. This not only helps to enhance the self-healing capacity of the regional ecosystem, but also contributes to global ecological security in China.

4 APPLICATION OF GREEN TECHNOLOGIES IN REALISING THE VALUE OF ECOLOGICAL PRODUCTS IN THE UPPER REACHES OF THE YANGTZE RIVER

In the upper Yangtze River basin, the application of green technologies is becoming a key factor in promoting the realisation of the value of ecological products. With the growing awareness of ecological protection and the promotion of the 'dual-carbon' goal, green technology is not only seen as a tool for reducing environmental pollution and ecological damage, but also as an important driver for economic transformation and sustainable development. In this region, technological innovations in the fields of green agriculture, renewable energy and eco-tourism have increased the added value of local eco-products, and at the same time promoted the harmonious development of ecology and economy.

First, the promotion and application of green agricultural technology is an important aspect of realising the value of ecological products. The upper reaches of the Yangtze River have effectively enhanced the sustainability of agricultural production through the introduction of water-saving irrigation systems, the use of bio-pesticides and organic

fertilisers. These technologies have not only reduced the reliance on chemical substances and lowered the burden of agriculture on the environment, but also improved the quality and market competitiveness of agricultural products, enabling agricultural products from this region to gain higher recognition and better prices in the market.

Secondly, the application of renewable energy technologies also plays an important role in the upper reaches of the Yangtze River. The region's abundant hydropower, solar and wind resources provide a natural advantage for the development of green energy. The construction of small hydropower plants, solar power facilities and wind farms not only effectively reduces the use of fossil fuels and carbon emissions in the region, but also provides local communities with a stable and sustainable energy supply. These green energy projects not only protect the ecological environment, but also lead to new employment opportunities and economic activities, enhancing the economic autonomy and development potential of the communities.

Finally, eco-tourism, a typical example of using green technologies to enhance the value of ecological products, has also been widely applied in the upper reaches of the Yangtze River. The construction of eco-trails, bird-watching platforms and other low-impact tourism facilities, as well as the development of tourism products centred on nature conservation and cultural experience, have not only attracted domestic and foreign tourists, but also promoted the development of the local economy and culture [10]. At the same time, the promotion of this tourism model has helped raise public awareness of and participation in ecological conservation, further promoting the dissemination of ecological culture and the protection of the ecological environment.

Through the application of these green technologies, the ecological products of the upper reaches of the Yangtze River are not only effectively realised in terms of ecological value, but also provide a new impetus and direction for the transformation and upgrading of the regional economy. This green technology-driven development model demonstrates the feasible path by which environmental protection and economic development can complement each other and advance together.

5 CONSTRUCTION OF MECHANISMS FOR REALISING THE VALUE OF ECOLOGICAL PRODUCTS

In the Upper Yangtze River Basin, the key to building a mechanism for realising the value of ecological products lies in the integration of policy-driven, market-based mechanisms and community participation, in order to form a win-win ecological and economic system for all parties. The successful implementation of this mechanism will not only promote ecological protection in the region, but also drive economic development and enhance the quality of life of the community.

First, policy-driven plays a fundamental role in the mechanism of realising the value of ecological products. By formulating and implementing relevant environmental policies and regulations, the government provides a legal basis and operational framework for the production and marketisation of eco-products. For example, the government can encourage enterprises and farmers to adopt environmentally friendly technologies and methods and produce products that meet ecological protection standards by providing incentives such as tax concessions, financial subsidies and technical support. At the same time, the government also needs to strengthen its supervision of environmental protection and ensure that all environmental protection laws and regulations are effectively enforced, so as to maintain the quality of ecological products and fair competition in the market.

Secondly, the effective operation of the market mechanism is an important means to promote the realisation of the value of ecological products. By establishing and perfecting the market system for ecological products, we can effectively connect ecological products with

consumer demand and realise the value of ecological products. The market mechanism also includes reasonable pricing of ecological products, reflecting their ecological value and scarcity, as well as improving the market recognition and consumer acceptance of ecological products through brand building and marketing strategies. In addition, the development of e-commerce platforms to expand the sales range and market share of ecological products is also an effective way to realise the value of ecological products.

Finally, community participation is also crucial for realising the value of ecological products. As the direct beneficiaries and participants of ecological protection, community residents' awareness of participation and ability to act directly affect the effectiveness of the mechanism for realising the value of ecological products. Therefore, raising the environmental awareness of community residents and encouraging them to participate in the production and sale of ecological products is the key to realising the value of ecological products. At the same time, enhancing residents' ecological protection skills and sustainable lifestyles through community training and education can further contribute to the enhancement of the value of ecological products and the improvement of the ecological environment.

Through the synergy of these three aspects, the Upper Yangtze River Basin can effectively build a mechanism for realising the value of ecological products that promotes a win-win situation for both ecology and economy, which not only protects the ecological environment, but also provides more economic opportunities and a better quality of life for local residents. The implementation of such a mechanism will be an important support for achieving sustainable regional development.

6 SUGGESTED PATHWAYS AND STRATEGIES FOR REALIZATION

In the process of realising the value of ecological products in the Upper Yangtze River Basin, a series of strategies and paths need to be adopted to ensure that the effects are maximised. These strategies should not only focus on the promotion of technology and policies, but also strengthen the participation of all sectors of society, so as to form an all-round implementation system.

First, technological innovation and promotion are key paths to realising the value of ecological products. The Upper Yangtze River Basin should continue to develop and apply green technologies that are suitable for the local environment, such as efficient water-saving technologies, organic agriculture, and clean energy technologies. The promotion of these technologies can effectively reduce environmental pollution and improve resource utilisation efficiency, while increasing the market competitiveness of ecological products. The government can encourage enterprises and scientific research institutions to carry out research and development and application of relevant technologies by setting up a green technology research and development fund, providing tax breaks and other policy support.

Secondly, policy formulation and implementation supervision is another important aspect to ensure the realisation of the value of eco-products. Local governments should formulate eco-protection and development policies in line with regional characteristics according to the actual situation, and clarify the production standards and market access conditions for eco-products. At the same time, it is also crucial to strengthen the enforcement of policies and the monitoring mechanism to ensure that all participants comply with the regulations, and that the policies are continuously optimised and adjusted to meet environmental changes and market demands.

In addition, public education and awareness-raising are social pathways to realising the value of eco-products. Through education and publicity, public awareness and participation in ecological protection can be raised, especially to enhance consumers' knowledge and willingness to buy ecological products. Local governments and NGOs can join forces with

schools and the media to carry out a variety of educational activities, such as lectures on ecological conservation and community activities on environmental themes, to make the public aware of the importance of ecological conservation and its contribution to improving the quality of life.

Through the implementation of these strategies, the Upper Yangtze River Basin will not only effectively realise the value of ecological products, but also promote the sustainable development of the regional economy, achieving a win-win situation for both ecology and economy. The joint efforts of the government, enterprises and the public will be an indispensable force in this process. This comprehensive implementation path and strategy proposal provides a clear and feasible path for ecological protection and economic development in the Upper Yangtze River Basin.

7 CONCLUSIONS AND OUTLOOK

By exploring the mechanisms and pathways through which green technologies can realise the value of ecological products in the upper Yangtze River Basin under the 'dual-carbon' goal, this study reveals a number of important findings and insights. Firstly, the application of green technologies has a significant effect on improving the ecological environment of the upper Yangtze River, and can effectively promote the value of ecological products. Through technological innovation and promotion, the market competitiveness and economic value of ecological products can be enhanced while ensuring environmental protection. Secondly, the effective combination of policy-driven and market mechanism provides strong support for the marketisation of ecological products. The government's policy guidance and the improvement of the market mechanism have jointly promoted the realisation of the value of ecological products, demonstrating the synergistic effect of ecological protection and economic development.

Looking ahead, the mechanism for realising the value of ecological products in the Upper Yangtze River Basin under the guidance of the 'dual-carbon' target will face more opportunities and challenges. With the continuous impact of global climate change and the evolution of domestic and international ecological protection policies, the ecological product development strategy in the region needs to be more flexible and innovative. Technological progress remains the most critical driver of eco-product value, and R&D investment in green technologies should be increased in the future, especially in clean energy, biodiversity conservation and resource recycling. In addition, strengthening cross-regional cooperation and establishing a broader platform for eco-product exchanges and co-operation will help to share experiences, resources and technologies, and jointly promote the sustainable development of regional ecology and economy.

On this basis, future research needs to further explore how to optimise policy formulation and implementation mechanisms to ensure the effectiveness of mechanisms for realising the value of eco-products. Meanwhile, public education and awareness-raising strategies should also be continuously promoted to enhance community residents' understanding of and participation in ecological conservation. Through these comprehensive measures, the Upper Yangtze River Basin will be more likely to achieve its dual ecological and economic goals and contribute to environmental sustainability in China and globally.

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